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Progress in Oceanography 73 (2007) 231–241
Progress in Oceanography
www.elsevier.com/locate/pocean

Volume flux and fresh water transport associated with the East Icelandic Current

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Accepted 19 November 2006
Available online 21 April 2007

Abstract

The importance of the circulation of fresh water within the Nordic Seas has frequently been pointed out, especially its effect on de\ep water formation and therefore possibly on the thermohaline circulation. The main source of fresh water is the East Greenland Current entering the Nordic Seas through Fram Strait. The Jan Mayen Polar Current and the East Icelandic Current (EIC) carry a part of the fresh water into the Greenland and Iceland Seas respectively. As a part of the EU project VEINS, Aanderaa current meters were deployed on two moorings within the EIC from June 1997 to June 1998 on a standard CTD section from Langanes, Northeast Iceland, to the central Iceland Sea in the direction towards Jan Mayen. The current was mainly concentrated along the slope where it was baroclinic, while over the deeper part a weak barotropic flow was observed. Geostrophic calculations, referenced to the current meter data, were used for estimating the volume flux and fresh water transport with the current. The total transport over the section towards the east was found to be 2.5 Sv. The fresh water transport relative to a salinity of 34.93, above 170 m, amounted to 5.5 mSv. This is roughly 4% of the fresh water transport through Fram Strait. This transport is put into a long-term perspective using hydrographic data from the Langanes section.

Keywords: East Icelandic Current; Iceland Sea; Slope current; Fresh water; Transport; Circulation

1. Introduction

The freshwater flux from the Arctic Ocean through Fram Strait, between Spitsbergen and Greenland, has received increasing interest in recent years. This is due to the role that fresh water plays in the stratification of the waters in the Greenland and Iceland Seas and its effect on the deep water formation and therefore on the thermohaline circulation. Aagaard and Carmack (1989) estimated the fresh water transport within the East Greenland Current (EGC) through Fram Strait, using 34.93 as reference salinity, to be 125 mSv (1 mSv = 1000 $m^3 s^{-1}$). The solid part of this was found to be 88 mSv while the rest was flow in liquid form. More recent estimates of the sea ice part, based on multi-year measurements, include

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0079-6611/$ - see front matter © 2007 Elsevier Ltd. All rights reserved.
doi:10.1016/j.pocean.2006.11.003

70 mSv by Kwok et al. (2004) and 76 mSv by Widell et al. (2003). Less information is available on the liquid part of the flow, which Aagaard and Carmack (1989) estimated to be 37 mSv using the current meter and hydrographic data available at that time. Meredith et al. (2001) derived a considerably higher value for this flow or 63 to 116 mSv. There is therefore a considerable uncertainty in the value of the fresh water flux through Fram Strait. This fresh water continues to flow south along the Greenland coast with the EGC towards Denmark Strait (Fig. 1).

There are in the Nordic Seas two main escape routes for fresh water from the EGC and into the Greenland and Iceland Seas. In the Greenland Sea this is the Jan Mayen Polar Current north of the Jan Mayen Fracture Zone and within the Iceland Sea the East Icelandic Current (EIC). The fresh water, that reflects the amount of Polar water present within the EIC that transports it along the slope of the north Icelandic shelf towards east and then along the Iceland-Faeroe Ridge, has profound effects on the physics and biology in the area. It stratifies the water column, making deep convection less likely to occur thus affecting the thermohaline circulation. Within the EIC the stratification may also affect both the timing and magnitude of the primary production (Gudmundsson, 1998). The EIC is important for the ecology of the area through which it flows and is e.g. believed to influence the migration pattern of the Norwegian spring spawning herring (Stefánsson and Jakobsson, 1989). It is therefore very important to know the fresh water flux within both the EIC and the Jan Mayen Polar Current to be able to estimate how much of the fresh

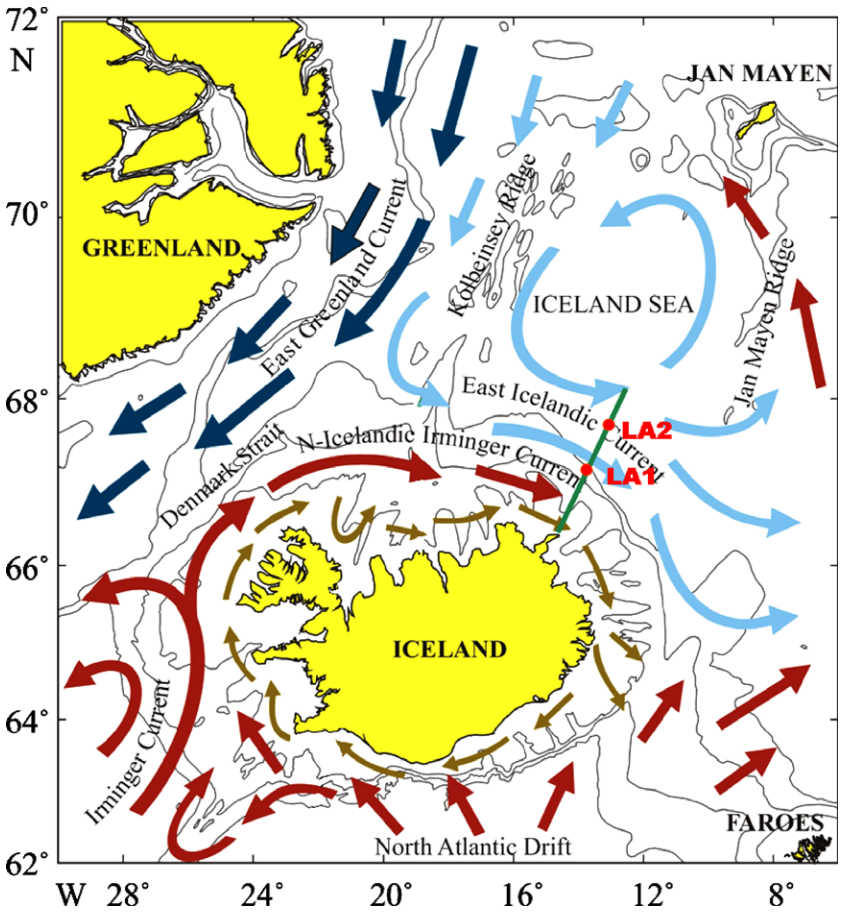

Fig. 1. A map showing the surface circulation in the ocean around Iceland, cf. Vilhjálmsson (2002). Red arrows indicate the circulation of warm and saline Atlantic water; dark blue, cold low salinity polar water of the East Greenland Current; light blue, Arctic water of the Iceland Sea including the East Icelandic Current. The current meter positions LA1 and LA2 are shown as well as the Langanes CTD section in green. The depth contours are 200, 500 and 1000 m.